PREPARING COLLECTIONS OF THE MOLLUSCA FOR EXHIBITION AND STUDY[1]

BY

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The Mollusca form a large group of the Animal Kingdom and members of this phylum are used for economic or biologic study by many biologists, zoologists, geologists, ecologists, and others interested in the study of animal life. Collections are also made for their beauty or interest by amateur students. Whatever the cause of interest it is important that the collections made should be properly prepared and preserved for future consultation. The good appearance and permanence of a collection of mollusks depend very largely upon the care taken in cleaning and preparing the individual specimens. The modus operandi varies with the size and the kind of mollusk.

CLEANING THE SPECIMENS

Mussels or River Clams. The river mussels, when only the shells are to be preserved, should be placed in boiling water which will cause the valves to open slightly. The adductor muscles may be cut with a thin-bladed knife and the animal matter removed. Care should be taken to remove all of the animal matter from the region of the muscles where it is strongly fastened. During this process the collector must avoid breaking or injuring the edge of the shell where the substance is very thin, the new shelly matter as well as the epidermis or periostracum being newly formed at this part of the shell. This is especially true of the thin-shelled mussels like *Anodonta*. After removing the animal parts the shells should be washed carefully to remove the mucus and any parts of the animal remaining. Care must be exercised to avoid breaking the ligament which holds the two valves of the shell together. When thoroughly cleaned the two valves may be tied together with *white* string (*never* use colored string for it will mark the shells) and the shells laid on boards or other objects to dry in a warm place. Never allow the sun to shine on specimens of this kind for they will then dry too quickly and the epidermis will peel off. A few shells of each lot should be broken apart so that the interior, especially the hinge structure, may be studied.

Many shells will be marred by incrustations of lime or other matter. This may be removed with muriatic or oxalic acid, which may be applied with a small camel's hair brush. As these acids, especially muriatic acid, readily attack that part of the shell not protected by the horny epidermis,

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the specimens should be washed carefully and quickly after using the acid. Many shells may need to be scrubbed with a small scrubbing brush or a nail brush to remove the extraneous matter. In some cases, however, it may be desirable to preserve the shells in their natural state, with all the incrustations and other foreign matter attached, to indicate the character of the water or bottom in which the animals lived. This may be necessary in some ecological studies. After the shells are thoroughly dry the strings may be removed and the surface of the shells rubbed with vaseline. This will usually prevent the epidermis from peeling or cracking and will give the shell the appearance it had when living in the water. Great care should be used to see that all of the surplus vaseline is removed or the surface will become sticky and unsightly. A soft rag may be used to rub the shells perfectly dry and clean.

Finger-nail Clams-Sphaeriidae. The smaller bivalves—*Sphaerium, Musculium, Pisidium*—are usually too small for the animal to be removed from the shell and they may be killed in 70 per cent alcohol from which they may be removed and dried in a few days. In the case of the larger *Sphaerium* the animal may be removed, after having been killed by boiling or by preservation in alcohol for a few days. As the valves of the shell are liable to open after being cleaned, and as they are usually too small to be tied together, they may be wrapped tightly in a plain piece of tissue paper until dry, when the paper may be removed. No oil or other preservative should be used for these shells.

Fresh Water Univalves or Snails. The larger fresh water snails may be killed by boiling or by preservation for a few days in 70 or 80 per cent alcohol. The animals are then easily extracted with a dissecting needle. A needle with a curved or twisted point is more effective in removing the animal from the inner whorls than one with a straight point. In the large *Lymnaea, Planorbis,* and *Physa,* the animals are easily removable, but in the *Pleurocera, Campeloma,* and related genera, the animals must be removed with great care as the upper part of the animal, containing the liver and part of the sexual organs, is liable to break off and remain in the shell. When removing these animals, get a firm hold of the body with the dissecting needle and then by a slow, careful, twisting motion remove the animal. All animal matter should be removed from the large shells.

If there are incrustations or other foreign material on the surface of the shells this may be taken off with a brush, scraped off with a knife, or removed with the acids mentioned for mussel shells, oxalic acid being the best. The acids must be used with care that the fine texture of the shells may not be injured. In those species having an operculum, like *Campeloma* and *Pleurocera,* the opercula of a few individuals of each lot should be removed from the foot of the snail, dried, and placed inside the aperture of the shell, which may then be closed with a piece of fine cotton. It is

not a good idea to glue the operculum to the cotton because the inner side which bears the muscle scars for its attachment to the operculigerous lobe of the animal may be needed for study. All shells should be thoroughly dried before placing them in the cabinet and before placing the operculum in the aperture. It is well in the larger *Campeloma* and *Vivipara*, to wipe the surface gently with the rag used for vaselining the mussel shells, using the same care as recommended for that group in this particular. The smaller snails, *Amnicola*, *Valvata*, small Lymnaeas (*Galba*), *Ancylus*, etc., may be killed in 70 per cent alcohol, from which they may be removed in a few days and dried. The little fresh water limpets (*Ancylus*) should have the animal carefully removed with the point of the dissecting needle. As these small limpets are usually coated with foreign matter they may be effectively cleaned by being allowed to float, upside down, on the surface of a small quantity of oxalic acid, after which they may be washed and carefully wiped with a camel's hair brush. The shell is thus easily cleaned if held, aperture downward, on the tip of the index finger.

Land Shells. The larger land snails or Helices should be placed in warm water which should be quickly brought to the boiling point to kill the animals. It is of importance to be certain that the water is boiling for hot water will not kill the animal at once and it will then be difficult to remove from the shell. Land shells cannot be left too long in the boiling water because the fore part of the body is liable to break away from the part containing the liver, which will then remain in the upper whorls of the shell and be very difficult to remove. If not killed quickly by boiling, the columella muscle will not be loosened from the pillar lip and the animal cannot be pulled out without breaking in pieces. The larger species must be boiled for fully a minute but the smaller species, the size of *Polygyra hirsuta*, will be ready to have the animal removed in 10 or 15 seconds. To prevent loss in a large tin or pot it is well to place the snails to be boiled in a wire dipper which may be obtained in any 10 cent store.

To insure successful extraction of the animals it is necessary to use great care and plenty of time. The same curved dissecting needle mentioned previously is well suited for removing the animals of land snails, and the same twisting motion is necessary as described under fresh water snails. If the animal breaks during the operation, leaving a portion in the upper whorls of the shell, the remaining part may be removed with jets of water from a small syringe, preferably a fine-pointed dental syringe. It may be well sometimes to place the shell in alcohol for a day or two in order that the part of the animal left in the shell may be loosened, after which the syringe will usually remove the matter. Sometimes a vigorous shaking, or, with the hand holding the shell, striking the other hand or the thigh, will aid in loosening the refractory matter. Much

patience and some ingenuity is necessary in removing the animals from their shells in which the aperture is restricted or contracted by teeth or folds, and in these cases the fine syringe will be found useful to start the body from the shell. All shells should be washed out inside with the syringe and scrubbed on the outside with a tooth brush, or other small brush, to remove all traces of mucus, dirt, or other foreign matter. A gentle flow of water from a tap or faucet is very effectual in removing mucus and dirt from the interior of large shells. If the mucus is unusually adhesive, as is sometimes the case, it may be necessary to use a small piece of sponge or cotton attached to the curved dissecting needle, or held with a pair of curved forceps, to remove the unsightly material. Land shells do not require vaseline for the preservation of the epidermis as suggested for fresh water mussels and large water snails. When perfectly clean the shells may be laid on boards or other objects and laid in a convenient place to dry. Never allow shells to dry in the sun for they will crack and be spoiled for cabinet purposes. Too strong emphasis cannot be laid on the injunction to remove *all* animal matter from the larger land shells, which have a peculiarly offensive odor all their own if placed in a cabinet only partly cleaned.

The small land snails, especially the members of the Pupillidae and those snails having teeth or folds in the aperture, cannot well have the animals removed. If these are kept for a few days in a dry place the animal will retract well within the shell and they may then be placed in 30 or 40 per cent alcohol for twenty-four hours, after which they may be dried and no offensive odor will be retained. Vermin will not usually attack a shell that is thus well soaked in alcohol. When dirt of any kind remains attached to these small shells they may be effectually cleaned by being put in a bottle with fine, clean sand, and a vigorous shaking will remove the dirt. This process should not be used for fragile shells. It is especially effective with the Pupillidae.

Marine Shells. The directions given above for land and fresh water shells apply equally well for marine mollusks. The snails from the sea, however, are more difficult to prepare because of the more powerful columellar muscle by which the animal is attached to the shell. For the larger species of sea snails the curved dissecting needle will hardly be adequate to extract the animal. For this purpose nothing is better than a stout fish hook which has been heated and then bent in the form of a partial spiral. Plunging in cold water after shaping will return the temper of the steel sufficiently for the purpose for which it is made. The shank may be firmly fastened in a wooden handle made in convenient shape to fit the hand, and the result is a very useful implement. In extracting the larger animals from their shells, it is important that the hook be deeply and firmly buried in the large, tough muscle attached to the columella

pillar or axis of the shell. A strong, steady pull will usually bring the animal.

Bivalve shells, clams, may be treated in a similar manner to Unionidae mentioned on a previous page. Boring clams, like *Pholas*, *Teredo*, and others, will require special attention to preserve the extra pieces of shelly matter connected with shell. Small clams may be treated in the same manner as mentioned under finger-nail shells. The same may be said of the small snails which should be treated as the small fresh water or land snails. Marine shells may be killed in boiling water or by preservation in alcohol. As in the case of land and fresh water mollusks, formalin is not a good preservative on account of its action on the shells.

Many marine snails are encrusted with limy matter, the tubes of worms, the hard shelly bases of corallines, and the dried remains of sponges. These may be removed with an old file the end of which has been ground to a point. Little chisels and punches like engraver's tools are also excellent for this purpose. With care and experience the collector will be able to scale off the greater part of this extraneous matter without harming the shell beneath. The judicious use of muriatic acid will also help in the final cleaning process, but this reagent must be used with great discretion in order not to mar the surface of the shell.

Preparation for Anatomical Study

It is frequently desirable that some of the material collected should be preserved for the study of the animal. Fresh water pulmonates, such as *Lymnaea*, *Planorbis*, *Physa*, may be placed directly in 30 per cent alcohol, where they may remain for twenty-four hours. They should then be placed in 50 per cent alcohol for another twenty-four hours, and finally preserved in 75 or 80 per cent alcohol. The fresh water operculate snails may be preserved in the same manner, as may also most of the marine snail shells.

Land shells, however, must be killed in osmic acid or by drowning, the latter being the best, causing the animal to die in a fully expanded condition. For drowning, the writer has obtained the best results by placing the snails in a large, wide-mouthed bottle, filling the bottle level full with water and placing a heavy piece of glass over the water to exclude all air bubbles. In twelve to twenty-four hours the animals will be fully expanded and quite dead and may then be removed to 30, 50, and 80 per cent alcohol as recommended above for fresh water snails. Care must be exercised that the snails are not taken from the drowning water too soon, for in this case they will contract badly when placed in alcohol.

Final preservation may be made in a 2 per cent solution of formaldehyde, but alcohol is better for the flexibility of the animal, which has a

tendency to harden and become brittle in formaldehyde. Even in a weak solution of formaldehyde the shells gradually soften and easily break when handled. A recent examination of some molluscan material in a research collection of a well-known laboratory was found to be time wasted because the material had been preserved in formaldehyde, and the shells had softened and curled up, almost entirely losing their original character. Valuable material upon which scientific conclusions are based is thus liable to be ruined for future study and examination.

Slugs (*Limax*, etc.) and snails with small or very thin shells may be preserved as mentioned for the animals of land shells. The eggs of all mollusks, fresh water as well as land, should be preserved in alcohol, after passing through the different grades of the preservative. Some eggs, as those of *Pyramidula* and *Polygyra*, have a more or less hard shell and may be dried and preserved in bottles. In the case of large eggs of the Bulimi and other large land shells, they must be treated in the same manner as birds' eggs and the contents removed by means of an egg blow pipe. They may then be dried and placed in the collection.

For bringing out details of the surface structure of snails a 1 per cent solution of chromic acid has been found to be a good reagent. Müller's fluid is also an excellent fixing reagent. These reagents, however, harden the body to such an extent that it is often difficult to make gross anatomical examinations and the alcohol method described above is the best for all purposes. When using the fixing reagents mentioned it is highly important that the animals be washed thoroughly in running water before being transferred to the different grades of alcohol. Twelve to forty-eight hours will be necessary for this purpose, depending upon the size of the specimen treated. No specimens should be placed in strong alcohol at once as this reagent extracts the water so rapidly that the internal organs are shrunken and distorted. For sectioning and some histological purposes the hardening methods mentioned are excellent.

Preservation for Study or Exhibition

The method of preserving and arranging a collection of mollusks will depend wholly upon the purpose for which it was made. All collections may be roughly divided into two types, those for display and those for study. Each of these types requires a different treatment.

Collections for Display. Collections of this kind will probably be confined almost exclusively to museums of one kind or another. An exhibition collection of the Mollusca, even in a public museum, should be more or less synoptic in character, and arranged to show the principal features of classification, as well as facts relative to different kinds of habitats—ponds, rivers, swamps, shallow water, deep water, rocky shores,

sandy shores, forests, plains, and valleys—in short, the ecology of this type of animals. The geographic distribution—Arctic, temperate, tropic, island, continental, etc.—should be indicated by charts; the variation of individuals and the economic use made of certain species should also be clearly indicated. For some of this display, models may be used to illustrate ecology, geographic variation, and methods of life. Features of this kind add much to the value of a collection and are always interesting to those persons visiting a museum that are not particularly interested in the general subject of mollusks. Such economic displays as pearl buttons and the clams from which they are made, both fresh water and marine, shell money as used by the native tribes of this and other countries, mollusks used for food, injurious snails, pearls, and other topics of like nature, are very interesting, useful, and highly educational.

For exhibiting mollusks a strong, durable, attractive tablet is essential. Such an one can be made of heavy binder's board (no. 20) cut into convenient sizes and covered with such material as will give the best effect to the collection. Many shells will look well on a black background and these may be mounted on tablets that have been covered with a dull black paper. Dark shells look better on a light background, and for these the writer has used an ivory-colored cardboard known as Royal Worcester Bristol Board, a material that withstands the fading power of light better than any other paper used. For these light backgrounds the cardboard is cut just a trifle smaller than the tablet, the edges of which have previously been passépartouted with a dead black paper used for binding together lantern slides, and the light cardboard is glued to the tablet (glue being used only about the margin of the card), leaving a border of black. This method produces a handsome tablet that is both durable and attractive. When the label is attached (which should be made of the same cardboard used for the center of the tablet) the whole has a pleasing appearance. The sizes of these tablets, as used by the writer in his museum work, and found to be the most useful, may be 3 x 2, 3 x 3, 3 x 4, 3 x 6, 3 x 9, 6 x 6, 9 x 9, and 12 x 12 inches. All of these are multiples of the small unit, 3 x 2 inches.

To make an exhibit collection of the greatest value from a teaching standpoint, many drawings of structure and development, maps of distribution, and labels describing the function of organs, as well as notes of interest concerning the animals or shells, should be freely used. A famous museum man, Dr. G. Brown Goode, once said that a museum was a collection of labels illustrated by specimens, and while this axiom is pretty strong and the matter may be somewhat overdone, the fact nevertheless remains true that a collection for public exhibition must be largely explained or interpreted by means of illustrations, models, and descriptive labels. Perhaps the statement of the great British museum administrator,

Sir William H. Flower, more nearly describes the use and function of a museum, who says: "It is not the objects placed in a museum that constitute its value, so much as the method in which they are displayed and the use made of them for the purpose of education."

Printed labels are the best for permanent display, but as these are expensive the next best are typewritten labels which may be printed on a typewriter having a platen such as is used by the librarians for card catalog work. The ribbon should be black carbon. Where large shells or series of shells illustrating some feature of structure of variation are to be exhibited a uniform black or ivory-colored background may be employed, using a large sheet of dull black paper or a sheet of the bristol board mentioned above for tablets.

Cases. Nearly all molluscan shells are best displayed in horizontal or flat cases. Shelving in an upright case can be used, but this method of installation is not as attractive nor as easy to install as in a flat case. Very large specimens or material preserved in alcohol or other fluid (these should be flat-sided glass jars) are best shown in upright cases or in the A-cases that are now used in many museums. In some museums the space beneath the flat cases is utilized for the purpose of storing the study series in drawers. In some of the older museums these drawers have (or had) glass tops and the contents could be seen by the visitor by simply pulling out the drawer. Excepting where the matter of space is vital this should not be done. The open museum halls are poor places for the proper storage of a research series which must be consulted in the presence of curious visitors who greatly bother the student. These collections should be stored in drawer cabinets kept in rooms especially reserved for research collections and made convenient for their study. This subject is more fully treated on a later page.

For holding cards and labels in an upright position the writer has found the pins and ticket holders sold by stationers to serve the purpose admirably. For attaching specimens to tablets it is better to use wax than glue, the former being easy to remove if the shell is needed for examination, while glue is difficult to remove without injury to the shell. Bright, polished shells, like *Cypreaea* and *Oliva*, are difficult to attach to the tablets on account of their smoothness. The prepared clay known as 'plastene,' 'modelit,' and 'permodello' has been used to some extent by the writer and has been found excellent for this purpose, if the mixture does not have too large a percentage of oil, which discolors the tablet. By drying the clay a trifle the amount of oil may be reduced. This clay usually provides a mold in which the shell may be held in any desired position. The clay is made in several colors among which gray-green, terra cotta, or dark brown are the best. If the shells are of the common kind and are not likely to be needed for study the liquid glues will prove

the best medium for fastening the specimens to the tablets. The shells may be propped in any desired position until the glue hardens.

Collections for Study

While there are several ways in which a collection of mollusks can be installed for exhibition, there is but one good method of caring for a study or research series of these animals. The dry specimens should be kept in drawer-cabinets. In considering the size of the cabinet the dimensions of the primary unit, the individual tray containing the specimens must first be decided upon.

Pasteboard Trays. These should be made as multiples of the smallest unit. This unit may be 1 x 2 inches for the smallest species and 3 x 2 inches for the larger series, the unit of width here being three inches. If one desires to carry out the 1 x 2 unit for the entire series the larger trays may be multiples of two inches. The various sizes that are the most useful, as learned from experience, are as follows: a. 1 x 2, 2 x 2, 2 x 3, 2 x 4, 4 x 4, 4 x 6, 6 x 6, 6 x 9, 9 x 9, 12 x 12. b. 1 x 3, 2 x 3, 3 x 3, 3 x 4, 3 x 6, 3 x 9, 6 x 6, 9 x 9, 12 x 12. The depth of the trays should be one-half inch, except in the largest size which should be three-fourths of an inch in depth. The trays may be covered with black or white glazed paper which gives them a pleasing appearance. These trays can be made by any box manufacturer. Ingenious students may be able to make their own trays if they have the time. To do this pieces of cardboard should be cut as shown in figure 1 and the four pieces indicated by the dotted line, folded together and attached by adhesive paper. Trays of this kind can be quite economically made in a short time.

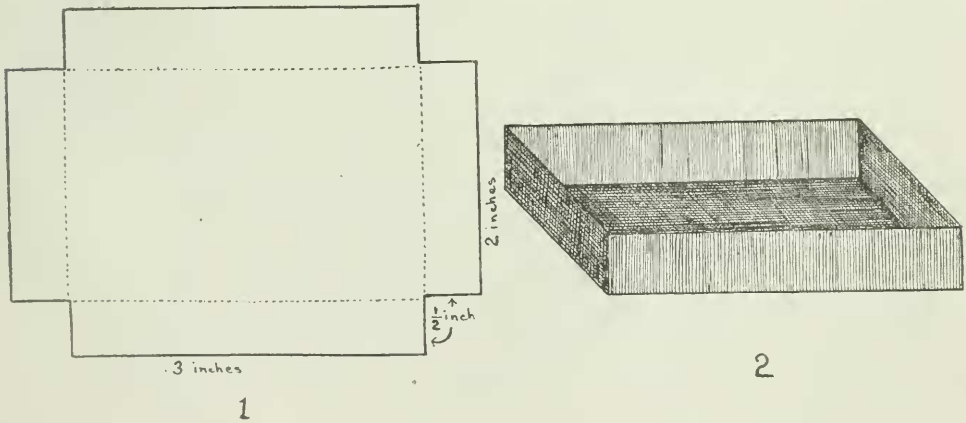

Fig. 1. Method of making a pasteboard tray for holding specimens.

Drawers. Having selected the size of the individual tray the next step is the dimension of the individual drawer. This should be made of a

size to contain the trays in a manner that there may be no waste space. A convenient size measurement, *inside*, is 15¼ x 21¼ inches. This allows five rows of the three inch unit trays which fit snugly in both dimensions of the drawer. If the two inch is used the drawer should be an inch wider or 16¼ inches. This will hold eight rows of the two-inch unit. The depth of the drawer will depend upon the character of the specimens it will contain. The smallest specimens need a drawer not over an inch in depth while the largest may require a depth of five or six inches. For an all around depth the writer uses a drawer two inches in depth and when larger specimens are installed the space of two drawers is used for one. This method has been found quite satisfactory and does not on the average take more room than when drawers are made of varying depth. It is seldom that specimens of greatly different size will be placed in the same cabinet, if room is wisely left for expansion, as should be done in the larger collections. The drawers mentioned above, which are in use in the University of Illinois Museum, are made of three-eighths inch material for the sides and ends and compo board is used for the bottom. These drawers require no handles and are very inexpensive.

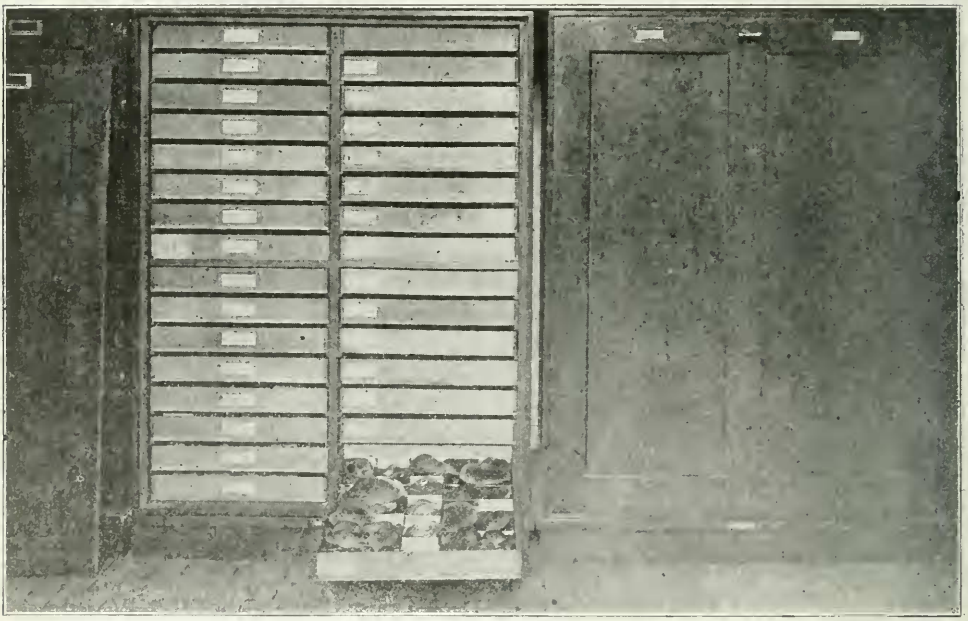

Fig. 2. Storage cabinet of drawers, 32 in each cabinet. An open drawer at the bottom shows the method of attaching labels to the back of the trays, as described in the text. University of Illinois Museum.

Cabinets. Having determined the sizes of the trays and the drawers the next thing is the size and style of the cabinet to contain the drawers. This should also be of the unit pattern so that several may fit together. The cabinets that are in use in the University of Illinois Museum, and which the writer has used in other museums he has had charge of, are shown in figure 2. These have the following dimensions:

Height 46, width 35½, depth 25 inches, outside measurements.

Drawer space 16⅛ inches wide, 2⅜ inches between the drawer runners.

Drawer runners ⅜ inch pieces sunk in the sides of case 3/16 inch.

Each case holds 32 drawers, 8 in each of four sections.

If the drawers are to be one inch deep the space between the runners should be 1-5/16 inches and the case would hold sixteen drawers in each section or sixty-four in each cabinet. The drawers are really ⅜ of an inch deeper than the dimensions given, this extra space being occupied by the runners. This space allows for extra large shells which may be included with the smaller ones. It is usually essential that all cabinets be of the same size and contain the same size of drawer so that additions and rearrangements may be made without unduly changing the contents of the drawers. This is very important when large additions are made necessitating the rearrangement of a large part of the collection. The drawers may be made of whitewood or basswood and simply shellaced or varnished. The cabinets are best if made of oak and finished in some dark color. The door of the cabinet should be made with a groove which extends entirely around the inner margin. This should fit into a tongue in the sides of the cabinet which also extends entirely around the cabinet. A piece of plush or felt fitted into the groove in the door will keep out the dust very effectually. Rubber has been used but this substance soon loses its resiliency and becomes worthless. The door should be made so that it may be entirely removed from the cabinet so that it will not be in the way when the collection is being studied. The photograph, fig. 2, indicates these points.

For smaller species, as the Pupillidae, Valloniidae, Sphaeriidae, Amnicolidae, as well as many groups of minute marine shells, the writer has used a case made to hold legal blanks which has proved very convenient and satisfactory. The dimensions of the drawers are:

Length 14¼, width 9, depth 1 inch; height of case of ten drawers 14 inches.

Each drawer holds 56 of the 1 x 2 inch unit trays or 560 trays in the cabinet. These cases are admirably adapted for holding these small shells, the drawers not being large enough to be cumbersome as is the case with a large drawer filled with these small trays. Several legal blank cases may be installed in one of the larger cabinets if it is desired to keep the cabinets perfectly uniform. The only possible criticism may be that

these legal blank cases are not perfectly dust proof and for permanent installation they should, perhaps, be enclosed in a cabinet as suggested above. Each drawer should be labelled with the name of the contents and each cabinet should have the name of the group it contains.

Bottles and Vials. For the safety of the collections glass bottles or vials should be provided for all shells under ¾ inch diameter. These should be made in different diameters but only of two lengths to fit the two unit widths of trays, two and three inches wide. Convenient sizes are as follows:

1¾ x ⅜, 1¾ x ½, 1¾ x ¾, 1¾ x 1 inch.

2½ x ¾, 2½ x ½, 2½ x ¾, 2½ x 1 inch.

Occasionally a larger size will be needed and a vial of 1½ inch diameter will be found useful. Only a few of this size will usually be required. The bottles known as shell vials, obtainable through almost any druggist, are especially adapted for the preservation of molluscan material and can be made of any of the sizes mentioned above. Short corks may be used but these should be rolled or squeezed to soften them so that the fragile tubes may not be broken when the cork is forced into the mouth of the vial. Rolling with a hard piece of wood or metal or pressing between a pair of large flat-nosed pliers will be found to accomplish this purpose admirably. Homeopathic vials may be used but these are not as good for dry specimens as the shell vials. Where expense is a serious item very good containers may be made by rolling a piece of stiff paper over a lead pencil or other round object the size of the required container and then gluing or pasting the edges together and closing one end with cotton. A cotton cork may also be used for the other end. The modus operandi of this method is indicated in figure 3. The cylinders may be made in lengths of legal blanks and then cut off in lengths to fit the trays.

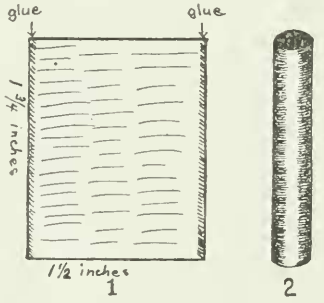

Fig. 3. Method of making paper shell tubes for holding small specimens.

Storage of Alcoholic Material

The proper storage of material preserved in alcohol is a matter requiring considerable attention. For this purpose homeopathic vials are better

than shell vials, because they are thicker and the strong, reinforced opening makes it possible to press a cork in very tightly, which retards evaporation of the liquid contents. Fairly large vials should be used even for small specimens in order that the storage may be uniform and liquid enough provided for the specimens to obviate frequent filling of the containers. Several sizes of bottles, 2, 4, 6 ounce, will be required to preserve the larger specimens. For mussels or series of specimens the clamp-top, all glass fruit jars (Atlas for example) are excellent for storage purposes. The old-fashioned Mason jar is not good because the liquid evaporates quickly and the metal screw top cannot be made permanently tight, besides becoming very unsightly in a short time. All of the jars should be of glass, except the rubbers, and these will need to be changed at intervals. The quart and pint jars have been found the most useful for purposes of storage, although the two quart size may be necessary at times.

Professor Frank Smith, of the Department of Zoology, University of Illinois, has made use of a method, first devised by the United States National Museum, for the preservation and storage of small specimens in vials which has much to commend it. The small vials, after being filled with alcohol or other preservative and having a wad of cotton placed in the mouth of the vial, are stored, bottom upward, in a large jar, of two liter capacity or larger, which is then filled with alcohol or other fluid. By this means the smaller vials may be kept without adding new liquid for a long time. Also, the large jar will become empty before the small vials and thus a warning is given before any damage can be done to the specimen. It often happens when valuable material is stored in many small vials that lack of proper attention permits the vials to become empty of fluid and the specimens dry out and are thus ruined.

Many zoologists will prefer the single bottle method, however, on account of the accessibility of the material, and for such the storage should be in standard racks, which may be stored on compo board shelves in the unit cabinets described previously. These racks will vary in width but should be of the same length. Convenient dimensions are as follows:

Vials, length 22, width 1⅜, height side 2¼, height front 3 inches.

Bottles, length 22, width 2¼, height side 2¼, height front 3 inches.

The general form used is indicated in figure 4. The stock should be

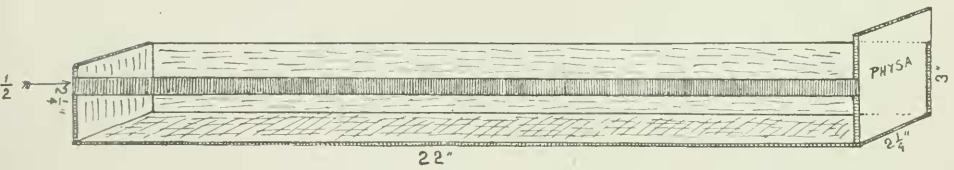

Fig. 4. Standard rack for holding alcoholic material, vial size.

3/8 inch for ends and 3/16 inch for bottom and sides. The large jars are perhaps best stored on shelves, although a rack similar to the one suggested for the vials and bottles, but made large enough to hold the jars, may be used. These racks may be made by any good carpenter or the lumber can be cut in a mill and the collector can put the racks together himself.

Registration and Labeling

Every set of specimens should have with it a label giving the name of the species, its locality, the principal ecological conditions under which it was found, the name of the collector, and the name of the authority who determined the species, as well as the date of collection. For this purpose cardboard labels just the width of the inside of the unit tray, 1 x 2 or 1 x 3 inches, may be used. The writer has found by experience that an excellent method of attaching the label to the tray is to glue the upper edge of the label to the upper margin of the unit width of the tray, at the back. When a whole drawer is arranged with the labels affixed in this manner the different species and their localities may easily be read. The specimens or vial of specimens lie in front of this label, as shown in figure 2. Genera or group divisions may be indicated on labels fastened to the bottom of the 1 x 2 or 1 x 3 inch trays. A sample of label in use in the Museum of the University of Illinois is shown below.

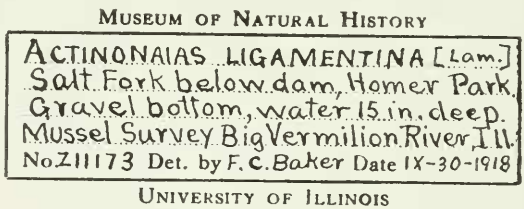

Fig. 5. Sample of label.

A catalog number should be given each set of specimens and this number should be placed in the vial containing the specimens or in the case of large specimens, written on the shell. For mussels both valves should be numbered. The best quality of indelible carbon ink should be used for this purpose. The writer has found Higgin's eternal ink (waterproof) to be the best for all purposes. The alcoholic material should have a label placed in each bottle written with the same kind of ink. Cardboard labels for this purpose are good. A permanent cloth known as 'mapstock' velum, sold by Jos. Bancroft & Sons Co., Rockford near Wilmington, Delaware, has been found admirable for this purpose.

A serial catalog kept in a book and a card catalog are invaluable for the proper recording and convenient classification of a collection. The book should be arranged to contain the serial numbers of the collection.

This volume may be made as elaborate as the pocket book of the collector will permit, varying from a simple note book to a large printed folio. For museums and large collections of private individuals the large folio is by all means the best. This may be arranged with the headings suggested below.

Cat. No.	Name	Locality	No. of specimens	Received from	Collected by	Date	Remarks

Other entries, such as original no., identified by, dry, alcoholic, etc., may be used if it is desired to elaborate further. For large institutions an accession catalog is necessary, in which is recorded the material by lots as received. In such cases an entry, accession number, is usually made room for after catalog number in the species catalog.

The card catalog should contain the references to all of the lots of one species, showing the different places from which they came, on one card, or each lot of a species may have all of the information recorded on one card. The first is more convenient for a small collection but the latter is perhaps better for a large institution or collection, giving all of the known data concerning each species lot on one card. The cards should be arranged alphabetically under the genera, the names of which should appear on guide cards, as is done for library card catalogs. Experience will suggest many ways in which the cataloging may be so arranged as to make the collection most useful, which is its legitimate function.

In closing let me say that a collection of mollusks is valuable principally for the information which it may contain. It is of paramount importance, therefore, that the data or information concerning each lot of specimens be made as accurate and complete as possible. This should be done in the field if possible and not left until later when memory may play one tricks as to the exact habitat of some specimens in a large lot. There are many questions still unsettled regarding the classification, geographic distribution, ecological habitat, and economic importance of this class of animals and any conscientious collector may add real scientific knowledge concerning some common species by exercising care and intelligence in making collections.

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